## Fishes of Goose Pond and Its Drainge Basin

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### Introduction

Goose Pond is geographically located 6.4 kilometers southeast of Mount Vernon in Black Township (Posey County) of southwestern Indiana. It lies within unglaciated terrain of the Wabash Lowland Region (19) in the Caborn Quadrangle (T7S, R13W, S14/23). Elevations within the drainage basin range from 107 to 113 meters above sea level.

Goose Pond is a lacustrine ecosystem situated in Cypress Slough, a large, shrub swamp covering 26.3 hectares dominated by buttonbush with some black willow and green ash (10) and drains an area of 67 square kilometers (5) before entering the Ohio River. Goose Pond covers 6 hectares of it and is lined by buttonbush and bald cypress, while its two neighboring, palustrine ponds cover areas of 3.2 and 1.0 hectares (Figure 1). Agricultural lands surround the Goose Pond basin.

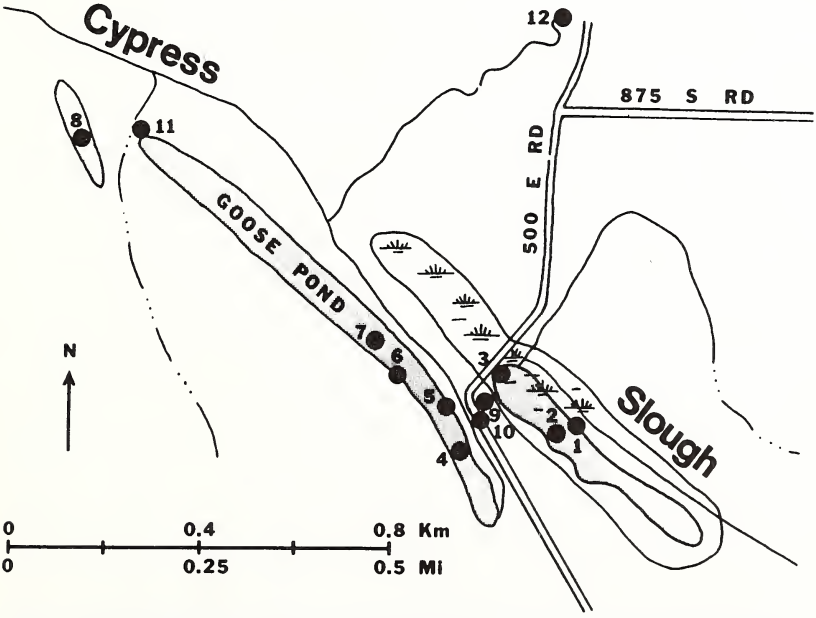


FIGURE 1. Map of Goose Pond and its drainage basin. Solid circles represent collecting sites.

Few ichthyological studies have been published on flood ponds or lakes in southwestern Indiana. Goose Pond was sampled in the summer of 1980 (8), while Hovey Lake (located 16 kilometers south of Mount Vernon, IN), a larger but similarly positioned lacustrine wetland, was investigated in 1942 (3). Fishes of Foots Pond, located in southwestern Indiana (Gibson County), was investigated in 1940-1941 (6, 9). To our knowledge, no other studies have been published.

The purpose of this study was to obtain base-line information on the type, relative abundance, distribution and species diversity of fishes in the Goose Pond drainage basin during winter to early spring of 1986. A secondary objective was to compare our results with the summer investigation of Goose Pond in 1980 (8).

## Materials and Methods

Twelve sites were sampled within the Goose Pond drainage basin (Figure 1) from 23 February to 1 April 1986. Fishes were collected using a combination of or singly a gill net (26.3 × 1.4 meter - 4 cm diamond mesh), hoop net (3.0 meter long × 0.6 meter diameter - 3 cm diamond mesh; 2 wings and 1 lead of 2.0 × 0.5 meter - 2 cm diamond mesh) and various-sized seines. They were a cast seine (1.8 meter diameter - 4 cm diamond mesh, bag seine (2 wings 3.0 × 1.2 meter; bag 1.2 × 1.2 meter - 1 cm diamond mesh), 4.3 × 1.2 meter seine (0.5 cm square mesh), and two 1.7 × 1.1 meter seines (0.3 and 0.6 cm ace mesh). Fishes were preserved in the field in 10% formalin following capture. Specimens are presently housed within the University of Southern Indiana collection.

Species diversity was determined using the Shannon-Weaver function (H′): $H' = C/N\ (N \log_{10} N - \Sigma n_i \log_{10} n_i)$, where C = 3.32 (the constant for conversions of logarithms from base 10 to base 2); N equals the total number of individuals in the population; and $n_i$ is the number of individuals of a particular species (4). Results are independent of sample size (15).

Fishes were keyed to species using standard references (1, 11, 14, 17, 18). All scientific and common names in this report are currently acceptable names (16).

## Results

Twenty-nine species of fish from 13 families were collected in the Goose Pond drainage basin (Figure 1). Fishes were collected from 3 distinct habitats. They were the open water ponds, wooded natural channels and tributary. The distribution and relative abundance of these species are shown in Table 1.

Distribution of fishes in the basin showed the emerald shiner as the dominant fish in the pond, channel and tributary habitats. The open water pond produced many gizzard shad too accompanied by, in fewer numbers though, the orangespotted sunfish, white crappie, bluegill, brook silverside and golden shiner. The emerald shiner and brook silverside were especially abundant at Stations 8 and 10, while the white crappie was for the most part collected along the buttonbush shores of Goose Pond. Inasmuch as the orangespotted sunfish and bluegill were collected together, their numbers were not the same. The orangespotted sunfish outnumbered the bluegill in the pond habitat, while the bluegill outnumbered the orangespotted sunfish in the channel habitat ($X^2 = 128.7$; $df = 1$; $p < .001$). Mosquitofish were found in both the channel and tributary habitats. In contrast, the spotfin shiner and blackstripe topminnow were collected predominately in the tributary. Incidental species with 7 or fewer individuals in the basin were the spotted gar, bowfin, grass pickerel, mississippi silvery minnow, river shiner, sand shiner, mimic shiner, bluntnose minnow, creek chub, smallmouth buffalo, bigmouth buffalo, yellow bullhead, green sunfish, warmouth, largemouth bass, black crappie, mud darter, slough darter and freshwater drum.

The most abundant fish in the basin was the emerald shiner. It comprised 51.4% of the total collection. Other fishes relatively abundant were the bluegill (15.8%), gizzard shad (11.6%), orangespotted sunfish (7.5%), white crappie (3.5%), brook silverside (2.3%) and golden shiner (1.7%). Together, these 7 species comprised 93.8% of the total catch, while the remaining 22 species made up 6.2%. The most common families represented were the minnow (55.0%), sunfish (27.7%) and herring (11.6%). Fishes from these families comprised 94.3% of the total catch, while disporportionately, the remain-

TABLE 1. Frequency, Location and Diversity of Fish Species in the Goose Pond Drainage Basin per Station.

| Stations | Pond | | | | | | | | | Channel | | Trib. | Total | % of Total Catch | % Frequency of Occurrence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| Species | | | | | | | | | | | | | | | |
| *Lepisosteus oculatus* (Spotted Gar) | | | | | | | 1 | | | | | | 1 | 0.1 | 8.3 |
| *Amia calva* (Bowfin) | | | | | | | 3 | | | | | | 3 | 0.2 | 8.3 |
| *Dorosoma cepedianum* (Gizzard Shad) | | 7 | 8 | 2 | 2 | 5 | 163 | 10 | | 2 | | | 199 | 11.6 | 66.7 |
| *Esox americanus* (Grass Pickerel) | | | | | | 1 | | | | | | | 1 | 0.1 | 8.3 |
| *Hybognathus nuchalis* (Miss. Silvery Minnow) | | | | | | | | | | 1 | | 1 | 2 | 0.1 | 16.7 |
| *Notemigonus crysoleucas* (Golden Shiner) | | | 5 | 1 | | | | 19 | | 2 | | 3 | 30 | 1.7 | 41.7 |
| *Notropis atherinoides* (Emerald Shiner) | | | | 6 | 18 | | | 374 | | 457 | | 24 | 879 | 51.4 | 41.7 |
| *Notropis blennius* (River Shiner) | | | | 2 | | | | | | 1 | | 1 | 4 | 0.2 | 25.0 |
| *Notropis spilopterus* (Spotfin Shiner) | | | | | | | | | | 3 | | 9 | 12 | 0.7 | 16.7 |
| *Notropis stramineus* (Sand Shiner) | | | | 1 | | | | | | | | | 1 | 0.1 | 8.3 |
| *Notropis volucellus* (Mimic Shiner) | | | | | | | | | | 6 | | | 6 | 0.4 | 8.3 |
| *Pimephales notatus* (Bluntnose Minnow) | | | 1 | 3 | | | | | | | | | 4 | 0.2 | 16.7 |
| *Semotilus atromaculatus* (Creek Chub) | | | | | | | | | | 1 | | 1 | 2 | 0.1 | 16.7 |
| *Ictiobus bubalus* (Smallmouth Buffalo) | | | | | 1 | | 1 | | | | | | 2 | 0.1 | 16.7 |
| *Ictiobus cyprinellus* (Bigmouth Buffalo) | | | | | | | 1 | | | | | | 1 | 0.1 | 8.3 |
| *Ictalurus natalis* (Yellow Bullhead) | | | | | | | 1 | | | | | 3 | 4 | 0.2 | 16.7 |
| *Fundulus notatus* (Blackstripe Topminnow) | 1 | | | | | | | 1 | | 5 | | 12 | 19 | 1.1 | 33.3 |
| *Gambusia affinis* (Mosquitofish) | | | | | | | | | | 5 | 4 | 6 | 15 | 0.9 | 25.0 |
| *Labidesthes sicculus* (Brook Silverside) | | | | 1 | | | | 32 | | 6 | | | 39 | 2.3 | 25.0 |
| *Lepomis cyanellus* (Green Sunfish) | | | | | | | | | | | | 1 | 1 | 0.1 | 8.3 |
| *Lepomis gulosus* (Warmouth) | 1 | | | | 1 | 1 | | | | 2 | | | 5 | 0.3 | 33.3 |
| *Lepomis humilis* (Orangespotted Sunfish) | 9 | | | 81 | 6 | | | 1 | | 20 | 12 | | 129 | 7.5 | 50.0 |
| *Lepomis macrochirus* (Bluegill) | 3 | | | 35 | 2 | 1 | 1 | 4 | 1 | 219 | 4 | | 270 | 15.8 | 75.0 |
| *Micropterus salmoides* (Largemouth Bass) | | | | 1 | | | 1 | | | | | | 2 | 0.1 | 16.7 |
| *Pomoxis annularis* (White Crappie) | 4 | | 1 | 1 | 45 | 2 | 4 | | | 3 | | | 60 | 3.5 | 58.3 |
| *Pomoxis nigromaculatus* (Black Crappie) | 1 | | 1 | 1 | 1 | 2 | | | 1 | | | | 7 | 0.4 | 50.0 |
| *Etheostoma asprigene* (Mud Darter) | | | | 1 | | | | | | | | | 1 | 0.1 | 8.3 |
| *Etheostoma gracile* (Slough Darter) | | | | 2 | | | | | | 3 | | | 5 | 0.3 | 16.7 |
| *Aplodinotus grunniens* (Freshwater Drum) | 1 | | | | 2 | | | | | | 2 | | 5 | 0.3 | 25.0 |
| Total Number of Species | 7 | 1 | 5 | 14 | 9 | 6 | 9 | 7 | 2 | 16 | 4 | 10 | 29 | | |
| Total Number of Individuals | 20 | 7 | 16 | 138 | 78 | 12 | 176 | 441 | 2 | 736 | 22 | 61 | 1709 | | |
| Species Diversity (H′) | 2.3 | 0 | 1.8 | 1.9 | 1.9 | 2.3 | 0.6 | 0.9 | 1.0 | 1.5 | 1.7 | 2.5 | | | |

ing 10 families made up 5.7%. The catfish and sucker families were poorly represented in the basin.

Species diversity in the basin ranged from 0 to 2.5 (Table 1) with an average of 1.5 ± 0.8. The highest species diversity index was found in the tributary (Station 12), while the lowest was found in the eutrophic waters at Station 2. Stations 1, 2 and 3 showed deep, organic sediments.

## Discussion

The most abundant fish in the study was the emerald shiner. Its superabundance suggests it as a winter-early spring resident in the Goose Pond basin. In summer though, their numbers in flood ponds in southwestern Indiana decrease (3, 6, 8) concurrent with an increase in their frequency in large rivers (2, 12, 13, 18), like the Ohio River, where it is the most abundant species (12, 13). In fall, the emerald shiner has been observed in large concentrations at the mouth of tributaries of large rivers (7, 12) suggesting a subsequent upstream migration. A fall migration into flood ponds is further supported by their high frequency in this winter-early spring investigation compared with 10 or fewer individuals reported from Goose Pond in the summer of 1980 (8). An even more exaggerated seasonal difference was shown by an absence of emerald shiners in Hovey Lake in the summer of 1942 (3) even though it was abundant in the Ohio River from 1920-1950 (18). Emerald shiners were uncommon in Foots Pond (7) where collections were made in summer and fall (9).

The bluegill, gizzard shad, orangespotted sunfish, white crappie, brook silverside and golden shiner were collected in modest numbers. They are common fishes in sloughs in southwestern Indiana (3, 6, 8) and have been reported previously from Goose Pond (8) with the exception of the brook silverside. We found most of the brook silverside at Station 8 (Figure 1) accompanied by many emerald shiners and some golden shiners. Station 8 was a small, somewhat hidden pond totally surrounded by a thick, wide stand of buttonbush. The pond had a hardpan, calcitic mud bottom and was well protected from holomixis. Such reduced wind effects promoted undisturbed sediments and consequently, reduced turbidity in the pond. Of the three ponds in the basin, this one was the least turbid. The sediment of Goose Pond was soft, calcitic mud and the remaining pond (east of Goose Pond) had deep, organic sediment. Emerald shiners, brook silverside and golden shiners prefer clear waters (17, 18) as was available at Station 8 and to a lesser extent, in the wooded natural channel. Ninety-five percent of the emerald shiners, 97% of the brook silverside and 70% of the golden shiners collected in this study came from Stations 8 and 10. Turbidity was the chief factor for the brook silverside's decline in Illinois (17) and Ohio (18). The emerald shiner and golden shiner are more turbidity tolerant fishes as demonstrated by their higher frequency of occurrence in this study.

In this investigation, the orangespotted sunfish outnumbered the bluegill in the open water pond habitat, while the opposite was true in the wooded natural channel. The bluegill prefers, clear, non-flowing waters with organic debris (1, 14, 17, 18), a habitat which was especially available in the channel. However, Goose Pond and its neighboring pond displayed turbid waters more suitable for the orangespotted sunfish which has a wide ecological tolerance and is usually found in turbid, non-flowing habitats (1, 14, 17, 18). The bluegill was the second most abundant fish in the study.

The gizzard shad was the third most abundant fish in the study. It, like the emerald shiner, shows a strong schooling tendency and is an Ohio River fish (2, 13, 18). The gizzard shad prefers turbid waters with an abundance of phytoplankton (17, 18). It is not surprising then that we found 94% of the gizzard shad, collected for the most part

by gill net, in the more turbid waters (with presumably more phytoplankton) of Goose Pond and to a lesser extent, in its neighboring pond (Stations 1 to 7).

Fourteen species were collected for the first time in the Goose Pond drainage basin. They were the grass pickerel, mississippi silvery minnow, river shiner, spotfin shiner, sand shiner, mimic shiner, bluntnose minnow, creek chub, smallmouth buffalo, bigmouth buffalo, brook silverside, largemouth bass, mud darter and slough darter. The low frequency of these fishes suggested a transient status. Such would be expected during flooded times of the year (winter-early spring) in the Goose Pond basin reflective of the rising and lowering of the Ohio River. During such times, it is not inconceivable that many creek and Ohio River fishes are forced or seek refuge in the calmer waters of the Goose Pond basin. Thus, the Goose Pond basin could be viewed as harboring more species at this time than in the summer. This assumption is supported by only 20 species reported in Goose Pond in the summer of 1980 (8) and 24 species from Hovey Lake during the summer of 1942 (3). In contrast, Foots Pond demonstrated 42 species from 14 families when sampled in the summer and fall (6, 9). Our study showed 29 species from 13 families or a 31% increase in richness from the earlier summer investigation (8).

The summer study of Goose Pond (8) reported 5 fishes not collected in this study. They were the shornose gar, carp, brown bullhead, flathead catfish and pirate perch. Of these fishes, the carp was especially abundant which suggested to us depressed summer oxygen levels in Goose Pond. In contrast, our study demonstrated more oxygen sensitive fishes as well as many more gizzard shad, emerald shiner, orangespotted sunfish and bluegill. A 48% difference in the fish community of the Goose Pond basin was shown when our winter-early spring results were compared with those results from the summer of 1908 (8). Fifteen fishes were common to both studies. They were the spotted gar, bowfin, gizzard shad, golden shiner, emerald shiner, yellow bullhead, blackstripe topminnow, mosquitofish, green sunfish, warmouth, orangespotted sunfish, bluegill, white crappie, black crappie and freshwater drum. These fishes are common inhabitants of flood ponds in southwestern Indiana (3, 6, 8).

## Conclusion

In Goose Pond and its drainage basin, 29 species of fish from 13 families were collected during the winter to early spring of 1986. The emerald shiner was the most abundant species. Other moderately abundant fishes were the bluegill, gizzard shad, orangespotted sunfish, brook silverside and golden shiner respectively. When compared with an earlier 1980 summer study of fishes in Goose Pond, this investigation showed a 31% increase in richness and a 48% difference in fish community composition. Such differences appeared seasonal and reflect the dramatic interplay adjacent rivers and creeks have on increasing and altering fish communities in flood ponds during flooded times of the year.

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